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(54) **Title:** USE OF COLOSTRININ, CONSTITUENT PEPTIDES THEREOF, AND ANALOGS THEREOF AS OXIDATIVE STRESS REGULATORS

(57) **Abstract:** The present invention provides methods that utilize compositions containing colostrinin, an constituent peptide thereof, an active analog thereof, and combinations thereof, as an oxidative stress regulator.

USE OF COLOSTRININ, CONSTITUENT PEPTIDES THEREOF, AND ANALOGS THEREOF AS OXIDATIVE STRESS REGULATORS

Background of the Invention

Colostrum is a component of the milk of mammals during the first few days after birth. Colostrum is a thick yellowish fluid and is the first lacteal secretion post parturition and contains a high concentration of immunogloblins (IgG, IgM, and IgA) and a variety of non-specific proteins. Colostrum also contains various cells such as granular and stromal cells, neutrophils, monocyte/macrophages, and lymphocytes. Colostrum also includes growth factors, hormones, and cytokines. Unlike mature breast milk, colostrum contains low sugar, low iron, but is rich is lipids, proteins, mineral salts, vitamins, and immunoglobins.

Colostrum also includes or contains a proline-rich polypeptide aggregate or complex, which is referred to as colostrinin. One peptide fragment of colostrinin is Val-Glu-Ser-Tyr-Val-Pro-Leu-Phe-Pro (SEQ ID NO:31), which is disclosed in International Publication No. WO-A-98/14473. Colostrinin and this fragment have been identified as useful in the treatment of disorders of the central nervous system, neurological disorders, mental disorders, dementia, neurodegenerative diseases, Alzheimer's disease, motor neurone disease, psychosis, neurosis, chronic disorders of the immune system, diseases with a bacterial and viral aetiology, and acquired immunological deficiencies, as set forth in International Publication No. WO-A-98/14473.

Although certain uses for colostrinin have been identified, it would represent an advancement in the art to discover and disclose other uses for colostrinin, or a component thereof, that are not readily ascertainable from the information currently known about colostrinin or its constituents.

Summary of the Invention

The present invention relates to the use of colostrinin, at least one constituent (i.e., component) peptide thereof, at least one active analog thereof (e.g., peptide having an N-terminal sequence equivalent to an N-terminal sequence of at least one of the colostrinin constituent peptides), and combinations thereof, as an oxidative stress regulator. These oxidative stress regulators can be used *in vitro* or *in vivo*, including internal and external use in animals including mammals such as humans. They can be used for preventative (i.e., prophylactic) treatments or for therapeutic treatments.

In one embodiment, the present invention provides a method for modulating (e.g., regulating or adjusting) the oxidative stress level in a cell. The method includes contacting the cell with an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof, under conditions effective to change (decrease or increase, but preferably, decrease) or prevent an increase in the level of an oxidizing species in the cell. By this it is meant that no increase or any amount of change (preferably, a decrease) in the level of one or more oxidizing species are within the scope of the invention, although not all oxidizing species monitored would necessarily have to demonstrate a change (preferably, decrease) or lack of an increase in its level. The cell can be in a cell culture, a tissue, an organ, or an organism. Hence, this method can be carried out *in vivo* or *in vitro*.

In another embodiment, the present invention provides a method for modulating the oxidative stress level in a patient. The method includes administering to the patient an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof, under conditions effective to decrease or prevent an increase in the level of an oxidizing species in the patient. By this it is meant that no increase or any amount of change (increase or decrease, but preferably, a decrease) in the level of one or more oxidizing species are within the scope of the invention, although not all oxidizing species monitored would necessarily have to demonstrate a decrease or lack of an increase in its level.

Yet another method of the invention is a method of modulating the oxidative stress level of the skin of a patient, and preferably, treating (prophylactically or therapeutically) oxidative damage to the skin of a patient. The method includes applying to skin a topical formulation (e.g., sun screen) that includes an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof, under conditions effective to change (increase or decrease, but preferably, decrease) or prevent an increase in the level of damage to a biomolecule of the patient. By this it is meant that no increase or any amount of change (increase or decrease, but preferably, decrease) in the level or damage to one or more biomolecules are within the scope of the invention, although not all biomolecules monitored would necessarily have to demonstrate a decrease or lack of an increase in its level of damage. The biomolecule may be selected from the group of a DNA, a protein, a lipid, or combinations thereof.

In other embodiments, the invention provides the use of an oxidative stress regulator in the manufacture of a medicament for use in the methods described herein.

A further embodiment of the invention is a cosmetic formulation that includes an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof.

As used herein, "a" or "an" means one or more (or at least one), such that combinations of active agents (i.e., active oxidative stress regulators), for example, can be used in the compositions and methods of the invention. Thus, a composition that includes "a" polypeptide refers to a composition that includes one or more polypeptides.

"Amino acid" is used herein to refer to a chemical compound with the general formula: NH_2—CRH—COOH, where R, the side chain, is H or an organic group. Where R is organic, R can vary and is either polar or nonpolar (i.e., hydrophobic). The amino acids of this invention can be naturally occurring or synthetic (often referred to as nonproteinogenic). As used herein, an organic group is a hydrocarbon group that is classified as an aliphatic group, a cyclic group or combination of aliphatic and cyclic groups. The term "aliphatic group"

means a saturated or unsaturated linear or branched hydrocarbon group. This term is used to encompass alkyl, alkenyl, and alkynyl groups, for example. The term "cyclic group" means a closed ring hydrocarbon group that is classified as an alicyclic group, aromatic group, or heterocyclic group. The term "alicyclic group" means a cyclic hydrocarbon group having properties resembling those of aliphatic groups. The term "aromatic group" refers to mono- or polycyclic aromatic hydrocarbon groups. As used herein, an organic group can be substituted or unsubstituted.

The terms "polypeptide" and "peptide" are used interchangeably herein to refer to a polymer of amino acids. These terms do not connote a specific length of a polymer of amino acids. Thus, for example, the terms oligopeptide, protein, and enzyme are included within the definition of polypeptide or peptide, whether produced using recombinant techniques, chemical or enzymatic synthesis, or naturally occurring. This term also includes polypeptides that have been modified or derivatized, such as by glycosylation, acetylation, phosphorylation, and the like.

The following abbreviations are used throughout the application:

A = Ala = Alanine	T = Thr = Threonine
V = Val = Valine	C = Cys = Cysteine
L = Leu = Leucine	Y = Tyr = Tyrosine
I = Ile = Isoleucine	N = Asn = Asparagine
P = Pro = Proline	Q = Gln = Glutamine
F = Phe = Phenylalanine	D = Asp = Aspartic Acid
W = Trp = Tryptophan	E = Glu = Glutamic Acid
M = Met = Methionine	K = Lys = Lysine
G = Gly = Glycine	R = Arg = Arginine
S = Ser = Serine	H = His = Histidine

Brief Description of the Drawings

The invention can be better understood with reference to the following detailed description together with the appended illustrative drawings in which like elements are numbered the same:

Figure 1. Principle of 2',7'-dihydro-dichlorofluorescein-diacetate assay. Chemical structure of H_2DCF-DA, H_2DCF and DCF (**A**). Uptake of H_2DCF-DA and fate of intracellular H_2DCF (**B**). Histogram: a change in DCF-mediated fluorescence intensity after treatment of H_2DCF-loaded cells with 50 µM H_2O_2 (**C**).

Figure 2. Cell cycle stage distribution of logaritmically replicating PC12 (A) and ECV304 (B) cell culture. Cells at approximately 70% confluence were harvested and prepared for cell cycle analysis. DNA content of cells was determined by flow cytometry. Each data points represent the mean fluorescence for 10,000 cells. Statistical analysis was carried out using ModFitLT V2.0 software.

Figure 3. Change in DCF fluorescence intensity as function of time, after addition of H_2O_2 or TPA to PC12 cells. Cells (10^6) were loaded with H_2DCF-DA (2.5 micromolar (µM)) for 12 minutes (min) and increasing concentrations of H_2O_2 (0, 12.5, 25 50 and 100 µM) or TPA (0, 50, 100, and 200 nanograms per milliliter (ng/ml)) was added. Fluorescence intensities were determined at 0, 5, 10 and 15 minutes after addition of H_2O_2 or TPA addition. Each data point represents the mean fluorescence for 10,000 cells.

Figure 4. Effect of N-acetyl-L-cysteine, butylated hydroxyanisole, and catalase on H_2O_2-induced H_2DCF oxidation. Treated and non-treated cells, loaded with H_2DCF-DA (2.5 µM) were exposed to 25 µM H_2O_2 and changes in fluorescence intensities were determined at 0 and 15 min by flow cytometry. Each data points represent the mean fluorescence for 10,000 cells.

Figure 5. Effect of colostrum, colostrinin, and its constituent peptides. Cells were H_2DCF-DA loaded and treated with compounds as described in the Examples Section. Changes in fluorescence intensity of treated and mock-treated cell cultures were determined as a function time (0, 5, 10, 15 minutes) after addition of 25 µM H_2O_2. The concentrations of colostrum colostrinin, and

its constituent peptides were 10 micrograms per milliliter (μg/ml). Each data points represent the mean fluorescence for 10,000 cells.

Figure 6. Reduction in TPA-induced reactive oxidizing species (ROS) levels in the presence of colostrum, colostrinin, and its constituent peptides as a function of time. Cells were H_2DCF-DA loaded and treated with compounds as described in the Examples Section. Changes in fluorescence intensity of treated and mock-treated cell cultures were determined as a function time (0, 5, 10, 15 minutes) after addition of 100 nanograms (ng) TPA. The concentrations of colostrum, colostrinin, and its constituent peptides were 10 μg/ml. Each data points represent the mean fluorescence for 10,000 cells.

Figure 7. Reduction in ROS levels by colostrum, colostrinin, and its constituent peptides from three independent experiments. H_2DCF-DA-loaded cells were treated with compounds as described in the Examples Section. Changes in fluorescence intensity of treated and mock-treated cell cultures were determined as a function time (0, 5, 10, 15 minutes) after addition of 100 ng TPA. The concentrations of colostrum, colostrinin, and its constituent peptides were 10 μg/ml. Each data points represent the mean fluorescence for 10,000 cells.

Detailed Description of Preferred Embodiments of the Invention

The inventors have found that colostrinin, at least one constituent peptide thereof, and/or at least one active analog thereof (e.g., a peptide having an N-terminal sequence equivalent to an N-terminal sequence of at least one of the colostrinin constituent peptides) can be used as general purpose oxidative stress regulator for use *in vitro* and *in vivo*, including for internal and external use in animals including mammals such as humans. Such oxidative stress regulators are referred to herein as "active agents." Significantly, such oxidative stress regulators can be administered alone or in various combinations to a patient (e.g., animals including humans) as a medication or dietary (e.g., nutrient) supplement in a dose sufficient to modulate the oxidative stress level throughout the patient's body, in a specific tissue site, or in a collection of tissues (organs). Alternatively, they can be administered topically to reduce the effects of

environmental- and oxidative stress-induced aging of the skin and to improve dermal appearance and youthfulness.

Reactive oxidizing species include superoxide, hydroxyl radicals, hydrogen peroxide, lipid peroxyl, oxoperoxinitrate, among others. Many of these are required for normal cell functions, but when present in excess, cells can become oxidatively stressed. Oxidative stress causes cellular damage, resulting in alteration of the redox state (e.g., depletion of nucleotide coenzymes and disturbance of sulfhydryl-containing enzymes), and saturation and destruction of the antioxidant defense and DNA repair system. If the cellular balance of the level of oxidizing species (e.g., reactive oxygen species and reactive nitrogen species) is not restored, several pathological processes are elicited, including DNA damage, lipid peroxidation, loss of intracellular calcium homeostasis, and alteration in cellular signaling and metabolic pathways. In addition, reactive oxidizing species may serve as intracellular messengers in gene regulatory and signal transduction pahtways at cellular level. For example, alterations in oxidative metabolism have long been known to result in protein-protein and protein-DNA interactions, consequently reactive oxidizing species are important in the regulation of promoter activities (gene regulation), and more complex cellular processes.

The compositions described herein can be utilized to modulate oxidative stress that can occur in a wide variety of situations. For example, they can be utilized to modulate oxidative stress during/after a premature birth, during/after a normal birth, as well as preventing/delaying aging in a patient. The present invention is advantageous in that modulating oxidative stress can result in enhanced wound healing, as well as the reduction and/or elimination of side effects of cosmetic procedures. Modulating oxidative stress can also result in enhanced repair, regeneration, and/or replacement, of cells, tissues, and/or organs (e.g., kidneys, liver, pancreas, skin, and other internal and external organs) either *in vitro* or *in vivo*, as well as enhanced preservation of such organs for transplantation, implantation, or scientific research.

In a preferred embodiment, the present invention provides a method for modulating the oxidative stress level in a cell. The method includes contacting

the cell with an active agent under conditions effective to change (either to increase or decrease, but preferably, to decrease) or prevent an increase in the level of at least one oxidizing species in the cell (relative to the same cell under the same conditions without the oxidative stress regulator). The cell can be in a cell culture, a tissue, an organ, or an organism. Hence, the method can be carried out *in vitro* or *in vivo*. The cell can be a mammalian cell, and preferably a human cell. In another preferred embodiment, the present invention provides a method for modulating the oxidative stress level in a patient. The method includes administering to the patient an active agent under conditions effective to change (increase or decrease, but preferably, decrease) or prevent an increase in the level of at least one oxidizing species in the patient (relative to the same conditions without the oxidative stress regulator).

The level of oxidative stress in a cell, for example, can be determined by the level of oxidizing species present, which can be determined by evaluating the abundance of oxidized molecules. For an *in vitro* and *in vivo* method, the level of at least one oxidizing species (and typically the level of all oxidizing species) in a cell or body fluid, for example, can be determined by the previously published method disclosed in R.B. Singh et al., Am. J. Cardiol., 76, 1233-1238 (1995). The level of increase or decrease in oxidizing activity is typically determined by comparison to a cell or other sample that has not been contacted with a composition described herein. Specific *in vitro* methods are described in the Examples Section.

Yet another method of the invention is a method of modulating the oxidative stress level of the skin of a patient, and preferably treating (prophylactically or therapeutically) oxidative damage to the skin of a patient. The method includes applying to skin a topical formulation (e.g., sun screen) that includes an active agent under conditions effective to change (increase or decrease, but preferably decrease) or prevent an increase in the level of damage to a biomolecule of the patient, such as a DNA, a protein, and/or a lipid. The level of oxidative damage to the skin of a patient can be determined by the level of protein oxidation using western blot immunoassays according to the method of E. Shacter et al., Free Radic. Biol. Med., 17, 429-437 (1995), the level of

oxidative damage to DNA using a DNA binding assay according to the method of I.A. Bespalov et al., J. Mol. Biol., 293, 1085-1095 (1998), and the level of oxidative modification of lipids as described by H. Esterbauer et al., Free Radic. Biol. Med., 11, 81-128 (1994).

Colostrinin is composed of peptides, the aggregate of which has a molecular weight range between about 5.8 to about 26 kiloDaltons (kDa) determined by polyacrylamide gel electrophoresis. It has a greater concentration of proline than any other amino acid. Ovine colostrinin has been found to have a molecular weight of about 18 kDa and includes three non-covalently linked subunits having a molecular weight of about 6 kDa and has about 22 wt-% proline. Ovine colostrinin has also been shown to contain the following number of residues per subunit: lysine - 2; histidine - 1; arginine - 0; aspartic acid - 2; threonine - 4; serine - 3; glutamic acid - 6; proline - 11; glycine - 2; alanine - 0; valine - 5; methionine - 2; isoleucine - 2; leucine - 6; tyrosine - 1; phenylalanine - 3; and cysteine - 0.

Colostrinin has been found to include a number of peptides ranging from 3 amino acids to 22 amino acids or more. These can be obtained by various known techniques, including isolation and purification involving eletrophoresis and synthetic techniques. The specific method of obtaining colostrinin and SEQ ID NO:31 is described in International Publication No. WO-A-98/14473. Using HPLC and Edelman Degradation, over 30 constituent peptides of colostrinin have been identified, which can be classified into several groups: (A) those of unknown precursor; (B) those having a β-casein homologue precursor; (C) those having a β-casein precursor; and (D) those having an annexin precursor. These peptides are described in International Patent Application PCT/GB00/02128, filed June 2, 2000, claiming priority to June 2, 1999, and can be synthesized according to the general method described in the Examples Section. These peptides (i.e., constituent peptides of colostrinin), which can be derived from colostrinin or chemically synthesized, include: MQPPPLP (SEQ ID NO:1); LQTPQPLLQVMMEPQGD (SEQ ID NO:2); DQPPDVEKPDLQPFQVQS (SEQ ID NO:3); LFFFLPVVNVLP (SEQ ID NO:4); DLEMPVLPVEPFPFV (SEQ ID NO:5); MPQNFYKLPQM (SEQ ID NO:6); VLEMKFPPPPQETVT

(SEQ ID NO:7); LKPFPKLKVEVFPFP (SEQ ID NO:8); VVMEV (SEQ ID NO:9); SEQP (SEQ ID NO:10); DKE (SEQ ID NO:11); FPPPK (SEQ ID NO:12); DSQPPV (SEQ ID NO:13); DPPPPQS (SEQ ID NO:14); SEEMP (SEQ ID NO:15); KYKLQPE (SEQ ID NO:16); VLPPNVG (SEQ ID NO:17); VYPFTGPIPN (SEQ ID NO:18); SLPQNILPL (SEQ ID NO:19); TQTPVVVPPF (SEQ ID NO:20); LQPEIMGVPKVKETMVPK (SEQ ID NO:21); HKEMPFPKYPVEPFTESQ (SEQ ID NO:22); SLTLTDVEKLHLPLPLVQ (SEQ ID NO:23); SWMHQPP (SEQ ID NO:24); QPLPPTVMFP (SEQ ID NO:25); PQSVLS (SEQ ID NO:26); LSQPKVLPVPQKAVPQRDMPIQ (SEQ ID NO:27); AFLLYQE (SEQ ID NO:28); RGPFPILV (SEQ ID NO:29); ATFNRYQDDHGEEILKSL (SEQ ID NO:30); VESYVPLFP (SEQ ID NO:31); FLLYQEPVLGPVR (SEQ ID NO:32); LNF (SEQ ID NO:33); and MHQPPQPLPPTVMFP (SEQ ID NO:34). These can be classified as follows: (A) those of unknown precursor include SEQ ID NOs:2, 6, 7, 8, 10, 11, 14, and 33; (B) those having a β-casein homologue precursor include SEQ ID NOs:1, 3, 4, 5, 9, 12, 13, 15, 16, 17, and 31; (C) those having a β-casein precursor include SEQ ID NOs:18 (casein amino acids 74-83), 19 (casein amino acids 84-92), 20 (casein amino acids 93-102), 21 (casein amino acids 103-120), 22 (casein amino acids 121-138), 23 (casein amino acids 139-156), 24 (casein amino acids 157-163), 25 (casein amino acids 164-173), 26 (casein amino acids 174-179), 27 (casein amino acids 180-201), 28 (casein amino acids 202-208), 29 (casein amino acids 214-222), 32 (casein amino acids 203-214), and 34 (casein amino acids 159-173); and (D) those having an annexin precursor include SEQ ID NO:30 (annexin amino acids 203-220).

A preferred group of such peptides includes: MQPPPLP (SEQ ID NO:1); LQTPQPLLQVMMEPQGD (SEQ ID NO:2); DQPPDVEKPDLQPFQVQS (SEQ ID NO:3); LFFFLPVVNVLP (SEQ ID NO:4); DLEMPVLPVEPFPFV (SEQ ID NO:5); MPQNFYKLPQM (SEQ ID NO:6); VLEMKFPPPPQETVT (SEQ ID NO:7); LKPFPKLKVEVFPFP (SEQ ID NO:8); and combinations thereof.

The polypeptides of SEQ ID NOs:1-34 can be in their free acid form or

they can be amidated at the C-terminal carboxylate group. The present invention also includes analogs of the polypeptides of SEQ ID NOs:1-34, which includes polypeptides having structural similarity with SEQ ID NOs:1-34. These peptides can also form a part of a larger peptide. An "analog" of a polypeptide includes at least a portion of the polypeptide, wherein the portion contains deletions or additions of one or more contiguous or noncontiguous amino acids, or containing one or more amino acid substitutions. An "analog" can thus include additional amino acids at one or both of the terminii of the polypeptides listed above. Substitutes for an amino acid in the polypeptides of the invention are preferably conservative substitutions, which are selected from other members of the class to which the amino acid belongs. For example, it is well-known in the art of protein biochemistry that an amino acid belonging to a grouping of amino acids having a particular size or characteristic (such as charge, hydrophobicity and hydrophilicity) can generally be substituted for another amino acid without substantially altering the structure of a polypeptide.

For the purposes of this invention, conservative amino acid substitutions are defined to result from exchange of amino acids residues from within one of the following classes of residues: Class I: Ala, Gly, Ser, Thr, and Pro (representing small aliphatic side chains and hydroxyl group side chains); Class II: Cys, Ser, Thr and Tyr (representing side chains including an -OH or -SH group); Class III: Glu, Asp, Asn and Gln (carboxyl group containing side chains): Class IV: His, Arg and Lys (representing basic side chains); Class V: Ile, Val, Leu, Phe and Met (representing hydrophobic side chains); and Class VI: Phe, Trp, Tyr and His (representing aromatic side chains). The classes also include related amino acids such as 3Hyp and 4Hyp in Class I; homocysteine in Class II; 2-aminoadipic acid, 2-aminopimelic acid, γ-carboxyglutamic acid, β-carboxyaspartic acid, and the corresponding amino acid amides in Class III; ornithine, homoarginine, N-methyl lysine, dimethyl lysine, trimethyl lysine, 2,3-diaminopropionic acid, 2,4-diaminobutyric acid, homoarginine, sarcosine and hydroxylysine in Class IV; substituted phenylalanines, norleucine, norvaline, 2-aminooctanoic acid, 2-aminoheptanoic acid, statine and β-valine in Class V; and naphthylalanines, substituted phenylalanines, tetrahydroisoquinoline-3-

carboxylic acid, and halogenated tyrosines in Class VI.

Preferably, the active analogs of colostrinin and its constituent peptides include polypeptides having a relatively large number of proline residues. Because proline is not a common amino acid, a "large number" preferably means that a polypeptide includes at least about 15% proline (by number), and more preferably at least about 20% proline (by number). Most preferably, active analogs include more proline residues than any other amino acid.

As stated above, active analogs of colostrinin and its constituent peptides include polypeptides having structural similarity. Structural similarity is generally determined by aligning the residues of the two amino acid sequences to optimize the number of identical amino acids along the lengths of their sequences; gaps in either or both sequences are permitted in making the alignment in order to optimize the number of identical amino acids, although the amino acids in each sequence must nonetheless remain in their proper order. Preferably, two amino acid sequences are compared using the Blastp program, version 2.0.9, of the BLAST 2 search algorithm, available at http://www.ncbi.nlm.nih.gov/gorf/bl2.html. Preferably, the default values for all BLAST 2 search parameters are used, including matrix = BLOSUM62; open gap penalty = 11, extension gap penalty = 1, gap x_dropoff = 50, expect = 10, wordsize = 3, and filter on. In the comparison of two amino acid sequences using the BLAST search algorithm, structural similarity is referred to as "identity." Preferably, an active analog of colostrinin or its constituent peptides has a structural similarity to colostrinin or one or more of its constituent peptides (preferably, one of SEQ ID NOs:1-34) of at least about 70% identity, more preferably, at least about 80% identity, and most preferably, at least about 90% identity.

Colostrinin or any combination of its peptide components or active analogs thereof can be derived (preferably, isolated and purified) naturally such as by extraction from colostrum or can be synthetically constructed using known peptide polymerization techniques. For example, the peptides of the invention may be synthesized by the solid phase method using standard methods based on either t-butyloxycarbonyl (BOC) or 9-fluorenylmethoxy-carbonyl (FMOC)

protecting groups. This methodology is described by G.B. Fields et al. in Synthetic Peptides: A User's Guide, W.M. Freeman & Company, New York, NY, pp. 77-183 (1992). Moreover, gene sequence encoding the colostrinin peptides or analogs thereof can be constructed by known techniques such as expression vectors or plasmids and transfected into suitable microorganisms that will express the DNA sequences thus preparing the peptide for later extraction from the medium in which the microorganism are grown. For example, U.S. Patent No. 5,595,887 describes methods of forming a variety of relatively small peptides through expression of a recombinant gene construct coding for a fusion protein which includes a binding protein and one or more copies of the desired target peptide. After expression, the fusion protein is isolated and cleaved using chemical and/or enzymatic methods to produce the desired target peptide.

The peptides used in the methods of the present invention may be employed in a monovalent state (i.e., free peptide or a single peptide fragment coupled to a carrier molecule). The peptides may also be employed as conjugates having more than one (same or different) peptide fragment bound to a single carrier molecule. The carrier may be a biological carrier molecule (e.g., a glycosaminoglycan, a proteoglycan, albumin or the like) or a synthetic polymer (e.g., a polyalkyleneglycol or a synthetic chromatography support). Typically, ovalbumin, human serum albumin, other proteins, polyethylene glycol, or the like are employed as the carrier. Such modifications may increase the apparent affinity and/or change the stability of a peptide. The number of peptide fragments associated with or bound to each carrier can vary, but from about 4 to 8 peptides per carrier molecule are typically obtained under standard coupling conditions.

For instance, peptide/carrier molecule conjugates may be prepared by treating a mixture of peptides and carrier molecules with a coupling agent, such as a carbodiimide. The coupling agent may activate a carboxyl group on either the peptide or the carrier molecule so that the carboxyl group can react with a nucleophile (e.g., an amino or hydroxyl group) on the other member of the peptide/carrier molecule, resulting in the covalent linkage of the peptide and the carrier molecule. For example, conjugates of a peptide coupled to ovalbumin

may be prepared by dissolving equal amounts of lyophilized peptide and ovalbumin in a small volume of water. In a second tube, 1-ethyl-3-(3-dimethylamino-propyl)-carboiimide hydrochloride (EDC; ten times the amount of peptide) is dissolved in a small amount of water. The EDC solution was added to the peptide/ovalbumin mixture and allowed to react for a number of hours. The mixture may then dialyzed (e.g., into phosphate buffered saline) to obtain a purified solution of peptide/ovalbumin conjugate. Peptide/carrier molecule conjugates prepared by this method typically contain about 4 to 5 peptides per ovalbumin molecule.

The present invention also provides a composition that includes one or more active agents (i.e., colostrinin, at least one constituent peptide thereof, or active analog thereof) of the invention and one or more carriers, preferably a pharmaceutically acceptable carrier. The methods of the invention include administering to, or applying to the skin of, a patient, preferably a mammal, and more preferably a human, a composition of the invention in an amount effective to produce the desired effect. The active agents of the present invention are formulated for enteral administration (oral, rectal, *etc.*) or parenteral administration (injection, internal pump, *etc.*). The administration can be via direct injection into tissue, interarterial injection, intervenous injection, or other internal administration procedures, such as through the use of an implanted pump, or via contacting the composition with a mucus membrane in a carrier designed to facilitate transmission of the composition across the mucus membrane such as a suppository, eye drops, inhaler, or other similar administration method or via oral administration in the form of a syrup, a liquid, a pill, capsule, gel coated tablet, or other similar oral administration method. The active agents can be incorporated into an adhesive plaster, a patch, a gum, and the like, or it can be encapsulated or incorporated into a bio-erodible matrix for controlled release.

The carriers for internal administration can be any carriers commonly used to facilitate the internal administration of compositions such as plasma, sterile saline solution, IV solutions or the like. Carriers for administration through mucus membranes can be any well-known in the art. Carriers for

administration oral can be any carrier well-known in the art.

The formulations may be conveniently presented in unit dosage form and may be prepared by any of the methods well known in the art of pharmacy. All methods include the step of bringing the active agent into association with a carrier which constitutes one or more accessory ingredients. In general, the formulations are prepared by uniformly and intimately bringing the active agent into association with a liquid carrier, a finely divided solid carrier, or both, and then, if necessary, shaping the product into the desired formulations.

Formulations suitable for parenteral administration conveniently include a sterile aqueous preparation of the active agent, or dispersions of sterile powders of the active agent, which are preferably isotonic with the blood of the recipient. Isotonic agents that can be included in the liquid preparation include sugars, buffers, and sodium chloride. Solutions of the active agent can be prepared in water, optionally mixed with a nontoxic surfactant. Dispersions of the active agent can be prepared in water, ethanol, a polyol (such as glycerol, propylene glycol, liquid polyethylene glycols, and the like), vegetable oils, glycerol esters, and mixtures thereof. The ultimate dosage form is sterile, fluid, and stable under the conditions of manufacture and storage. The necessary fluidity can be achieved, for example, by using liposomes, by employing the appropriate particle size in the case of dispersions, or by using surfactants. Sterilization of a liquid preparation can be achieved by any convenient method that preserves the bioactivity of the active agent, preferably by filter sterilization. Preferred methods for preparing powders include vacuum drying and freeze drying of the sterile injectible solutions. Subsequent microbial contamination can be prevented using various antimicrobial agents, for example, antibacterial, antiviral and antifungal agents including parabens, chlorobutanol, phenol, sorbic acid, thimerosal, and the like. Absorption of the active agents over a prolonged period can be achieved by including agents for delaying, for example, aluminum monostearate and gelatin.

Formulations of the present invention suitable for oral administration may be presented as discrete units such as tablets, troches, capsules, lozenges, wafers, or cachets, each containing a predetermined amount of the active agent

as a powder or granules, as liposomes containing the active agent, or as a solution or suspension in an aqueous liquor or non-aqueous liquid such as a syrup, an elixir, an emulsion, or a draught. The amount of active agent is such that the dosage level will be effective to produce the desired result in the subject.

Nasal spray formulations include purified aqueous solutions of the active agent with preservative agents and isotonic agents. Such formulations are preferably adjusted to a pH and isotonic state compatible with the nasal mucous membranes. Formulations for rectal or vaginal administration may be presented as a suppository with a suitable carrier such as cocoa butter, or hydrogenated fats or hydrogenated fatty carboxylic acids. Ophthalmic formulations are prepared by a similar method to the nasal spray, except that the pH and isotonic factors are preferably adjusted to match that of the eye. Topical formulations include the active agent dissolved or suspended in one or more media such as mineral oil, DMSO, polyhydroxy alcohols, or other bases used for topical pharmaceutical formulations.

Useful dosages of the active agents can be determined by comparing their *in vitro* activity and the *in vivo* activity in animal models. Methods for extrapolation of effective dosages in mice, and other animals, to humans are known in the art; for example, see U.S. Patent No. 4,938,949.

The tablets, troches, pills, capsules, and the like may also contain one or more of the following: a binder such as gum tragacanth, acacia, corn starch or gelatin; an excipient such as dicalcium phosphate; a disintegrating agent such as corn starch, potato starch, alginic acid and the like; a lubricant such as magnesium stearate; a sweetening agent such as sucrose, fructose, lactose or aspartame; and a natural or artificial flavoring agent. When the unit dosage form is a capsule, it may further contain a liquid carrier, such as a vegetable oil or a polyethylene glycol. Various other materials may be present as coatings or to otherwise modify the physical form of the solid unit dosage form. For instance, tablets, pills, or capsules may be coated with gelatin, wax, shellac, or sugar and the like. A syrup or elixir may contain one or more of a sweetening agent, a preservative such as methyl- or propylparaben, an agent to retard crystallization of the sugar, an agent to increase the solubility of any other

ingredient, such as a polyhydric alcohol, for example glycerol or sorbitol, a dye, and flavoring agent. The material used in preparing any unit dosage form is substantially nontoxic in the amounts employed. The active agent may be incorporated into sustained-release preparations and devices.

In a particularly preferred embodiment, the active agents of the present invention can be used in cosmetic formulations (e.g., skincare cream, sunscreen, decorative make-up products, and other dermatological compositions) in various pharmaceutical dosage forms, and especially in the form of oil-in-water or water-in-oil emulsions, solutions, gels, or vesicular dispersions. The cosmetic formulations may take the form of a cream which can be applied either to the face or to the scalp and hair, as well as to the human body. They can also serve as a base for a lipstick.

Particularly preferred cosmetic formulations can also include additives such as are usually used in such formulations, for example preservatives, bactericides, perfumes, antifoams, dyes, pigments which have a coloring action, surfactants, thickeners, suspending agents, fillers, moisturizers and/or humectants, fats, oils, waxes or other customary constituents of a cosmetic formulation, such as alcohols, polyols, polymers, foam stabilizers, electrolytes, organic solvents, or silicone derivatives.

Cosmetic formulations typically include a lipid phase and often an aqueous phase. The lipid phase can advantageously be chosen from the following group of substances: mineral oils, mineral waxes oils, such as triglycerides of capric or of caprylic acid, but preferably castor oil; fats, waxes and other natural and synthetic fatty substances, preferably esters of fatty acids with alcohols of low C number, for example with isopropanol, propylene glycol or glycerol, or esters of fatty alcohols with alkanoic acids of low C number or with fatty acids; alkyl benzoates; silicone oils, such as dimethylpolysiloxanes, diethylpolysiloxanes, diphenylpolysiloxanes and mixed forms thereof.

If appropriate, the aqueous phase of the formulations according to the invention advantageously includes alcohols, diols or polyols of low C number and ethers thereof, preferably ethanol, isopropanol, propylene glycol, glycerol, ethylene glycol, ethylene glycol monoethyl or monobutyl ether, propylene

glycol monomethyl, monoethyl or monobutyl ether, diethylene glycol monomethyl or monoethyl ether and analogous products, furthermore alcohols of low C number, for example ethanol, isopropanol, 1,2-propanediol and glycerol, and, in particular, one or more thickeners, which can advantageously be chosen from the group consisting of silicon dioxide, aluminium silicates, polysaccharides and derivatives thereof, for example hyaluronic acid, xanthan gum and hydroxypropylmethylcellulose, particularly advantageously from the group consisting of poly-acrylates, preferably a polyacrylate from the group consisting of so-called Carbopols, for example Carbopols of types 980, 981, 1382, 2984 and 5984, in each case individually or in combination.

A preferred cosmetic formulation is a sunscreen composition. A sunscreen can advantageously additionally include at least one further UVA filter and/or at least one further UVB filter and/or at least one inorganic pigment, preferably an inorganic micropigment. Ther UVB filters can be oil-soluble or water-soluble. Advantageous oil-soluble UVB filter substances are, for example: 3-benzylidenecamphor derivatives, preferably 3-(4-methylbenzylidene)camphor and 3-benzylidenecamphor; 4-aminobenzoic acid derivatives, preferably 2-ethylhexyl 4-(dimethylamino)benzoate and amyl 4-(dimethylamino)benzoate; esters of cinnamic acid, preferably 2-ethylhexyl 4-methoxycinnamate and isopentyl 4-methoxycinnamate; derivatives of benzophenone, preferably 2-hydroxy-4-methoxybenzophenone, 2-hydroxy-4-methoxy-4'-methylbenzophenone and 2,2'-dihydroxy-4-methoxybenzophenone; esters of benzalmalonic acid, preferably di(2-ethylhexyl) 4-methoxybenzalmalonate. Advantageous water-soluble UVB filter substances are, for example: salts of 2-phenylbenzimidazole-5-sulphonic acid, such as its sodium, potassium or its triethanolammonium salt, and the sulphonic acid itself; sulphonic acid derivatives of benzophenones, preferably 2-hydroxy-4-methoxybenzophenone-5-sulphonic acid and salts thereof; sulphonic acid derivatives of 3-benzylidenecamphor, such as, for example, 4-(2-oxo-3-bornylidenemethyl) benzenesulphonic acid, 2-methyl-5-(2-oxo-3-bornylidenemethyl) benzenesulphonic acid and salts thereof. The list of further UVB filters mentioned which can be used in combination with the active agent(s) according

to the invention is not of course intended to be limiting.

Examples

The invention will be further described by reference to the following detailed examples. The examples are meant to provide illustration and should not be construed as limiting the scope of the present invention.

MATERIALS AND EXPERIMENTAL PROCEDURES

Preparation of Peptides:

1. Wash pre-loaded resin with DMF (dimethylformamide), then drain completely.
2. Add 10 ml of 20% piperidine/DMF to resin. Shake for 5 minutes, then drain.
3. Add another 10 ml of 20% piperidine/DMF. Shake for 30 minutes.
4. Drain reaction vessel and wash resin with DMF four times. Then wash once with DCM (dichloromethanol). Check beads using the ninhydrin test - the beads should be blue.
5. The coupling step was carried out as follows:
   a. Prepare the following solution: 1 mmole Fmoc (i.e. fluorenylmethyloxycarbonyl) amino acid 2.1 ml of 0.45 M HBTU/HOBT (1 mmol) (2-(1H-benzotriazol-1-yl)-1,1,3,3-tetramethyluronium hexafluorophosphate/N-hydroxybenzotriazole-H_2O) 348 µl of DIEA (2 mmol) (diisopropylethylamine); and
   b. Add the solution to the resin and shake for a minimum of 30 minutes.
6. Drain reaction vessel and wash the resin again with DMF four times and with DCM once.
7. Perform the ninhydrin test: If positive (no colour) - proceed to step 2 and continue synthesis; If negative (blue colour) - return to step 5 and recouple the same Fmoc amino acid.

8. After the synthesis was complete, the peptide was cleaved from the resin with 5% H_2O, 5% phenol, 3% Thionisole, 3% EDT (ethanedithiol), 3% triisopropylsilane and 81% TFA for 2 hours.

9. After 2 hours, filter into cold MTBE (methyl t-butyl ether). The precipitated peptide was then washed twice with cold MTBE and dried under nitrogen gas.

10. The molecular weight of the synthesised peptides was checked by Matrix-Assisted Laser Desorption Time-of-Flight Mass Spectroscopy (LDMS), and the purity was checked by HPLC using a C-18, 300 Angstrom, 5 μm column.

Cell lines: PC12 cell line derived from medullary pheochromocytoma cells and immortalized human endothelial cells (ECV304: developed from the umbilical vein; K. Takashashi et al., In Vitro Cell Dev. Biol., 25, 265-274, 1990) were used to undertake studies described bellow. PC12 cells were obtained from the American Type Culture Collection. ECV304 cells were kindly provided by Dr. Goto (Patology Division, National Cancer Institute, Tokyo, Japan).

Cell culture conditions: PC12 and ECV304 cells were cultured in RPMI-1640 and M199 medium (Gibco-BRL, Life Technologies, Inc., Rockville, MD), respectively. The media were supplemented with 10% fetal bovine serum (Hyclone Laboratories Inc., Logan, UT), penicillin (100 U/ml) and streptomycin (100 μg/ml). To evaluate the oxidative stress regulatory activity of colostrinin and constituent peptides, cells were harvested at 70% confluence (log phase).

Flow cytometry: Fluorogenic, chemiluminescent, or chromogenic probes have been used extensively to monitor oxidative activity in cells. One of the most popular approaches involves the use of chemically reduced forms (nonfluorescent) of dyes such as fluorescein. After reaction with oxidizing species, these reduced compounds, which are poor fluorescens are oxidized resulting in a dramatic increase in fluorescence intensity. The use of 2'-7'-

dichlorofluorescin (H_2DCF) for this purpose is shown in **Figure 1A**. H_2DCF-DA is added to cells, where it diffuses across the cell membrane and is hydrolyzed by intracellular esterases to H_2DCF, which upon oxidation, yields the highly fluorescent DCF (**Figure 1B**). Oxidation may be achieved by reaction with H_2O_2 in the presence of peroxidase, cytochrome c, or Fe^{2+}. H_2DCF may also be oxidized by peroxynitrite, superoxide and nitric oxide (M. Tsuchiya et al., Methods Enzymol., 233, 128-140 (1994); C.P. LeBel et al., Chem. Res. Toxicol., 5, 227-231 (1992);

G. Rothe et al., J. Leukoc. Biol., 47, 440-448 (1990); J.A. Royall et al., Arch. Biochem. Biophys., 302, 348-355 (1993); and N.W. Kooy et al., Free Radic. Res., 27, 245-254 (1997).

Cells were (10^6 cells per ml) loaded with H_2DCF-DA (final concentration of 2.5 μM) for 2 min and treated for 10 min with increasing concentrations of individual constituent peptides, colostrinin or colostrum. H_2DCF-DA/constituent peptides-treated cells were exposed to H_2O_2 (25 μM) and a change in fluorescence intensity were determined as a function of time by flow cytometry. As a control, H_2DCF-DA-loaded cells in parallel were treated with H_2O_2 (12.5, 25, 50 μM) alone. A typical histogram is shown in **Figure 1C**. In additional control experiments antioxidants N-acetyl-L-cysteine and butylated hydroxyanisole were used. All assays were carried out in phenol red-free media, containing 1% fetal bovine serum and 10 mM HEPES (pH: 7.4).

Flow cytometry was performed on a FACScan flow cytometer (Becton Dickinson). The excitation and emission wavelength were 485 nanometers (nm) and 530 nm, respectively. Instrument calibration was performed daily using Calibrate Beads (BDIS) according to the recommendation of the manufacturer (Becton Dickinson). Each sample was run in the setup mode until a cell acquisition gate was established, at which point only events in this gate were acquired. 10,000 events were collected in all studies.

Cell viability assay: Cell viability was determined by flow cytometry after staining cells (10^6) with 1 μM propidium iodine. Cell suspensions with a viability of more than 95%, were used. Cell cycle stage distribution was

determined by DNA content measurement. A typical histogram is shown in **Figure 2.**

Materials: N-acetyl-L-cysteine, catalase, butylated hydroxyanisole and H_2O_2 were purchased from Sigma Chemicals Co. (St. Louis, MO). DCF, 2'-7'-dichlorofluorescin diacetate, and propidium iodine were purchased from Molecular Probes (Eugene, OR). Catalase (from beef liver, 65,000 U/mg crystalline suspension in water) was obtained from Boehringer-Mannheim (Indianapolis, IN). Stock solutions were prepared according to manufacturers' recommendations. RPMI-1640 and M199 and other medium supplements were purchased from Gibco-BRL, and fetal bovine serum was obtained from Hyclone, Inc.

RESULTS

Data summarized in attached Figures show that constituent peptides of colostrinin, colostrinin itself, and colostrum have significant oxidative stress regulating activity. These compounds did not interfere with cellular uptake of redox-sensitive 2', 7'-dihydro-dichlorofluorescein-diacetate. Also colostrum or colostrinin and its constituent peptides do not directly oxidize or reduce H_2DCF and DCF, respectively (data not shown). The oxidative stress regulating activity of SEQ ID NO:1, SEQ ID NO:7, SEQ ID NO:8, SEQ ID NO:3, SEQ ID NO:2, SEQ ID NO:4, and SEQ ID NO:5, SEQ ID NO:31, cholostrinin, and colostrum was similar in both PC12 (medullary pheochromocytoma) and ECV304 (immortalized human endothelial cells developed from the umbilical vein) cells indicating that their effect is not cell type specific (in this report data generated using PC12 cells are shown).

Although the invention has been disclosed with reference to its preferred embodiments, from reading this description those of skill in the art may appreciate changes and modification that may be made which do not depart from the scope and spirit of the invention as described above and claimed hereafter.

All references, patents, and patent applications cited herein are incorporated herein by reference in their entirety as if individually incorporated.

Sequence Listing Free Text

The following are all synthetic peptide sequences.

SEQ ID NO:1	MQPPPLP
SEQ ID NO:2	LQTPQPLLQVMMEPQGD
SEQ ID NO:3	DQPPDVEKPDLQPFQVQS
SEQ ID NO:4	LFFFLPVVNVLP
SEQ ID NO:5	DLEMPVLPVEPFPFV
SEQ ID NO:6	MPQNFYKLPQM
SEQ ID NO:7	VLEMKFPPPPQETVT
SEQ ID NO:8	LKPFPKLKVEVFPFP
SEQ ID NO:9	VVMEV
SEQ ID NO:10	SEQP
SEQ ID NO:11	DKE
SEQ ID NO:12	FPPPK
SEQ ID NO:13	DSQPPV
SEQ ID NO:14	DPPPPQS
SEQ ID NO:15	SEEMP
SEQ ID NO:16	KYKLQPE
SEQ ID NO:17	VLPPNVG
SEQ ID NO:18	VYPFTGPIPN
SEQ ID NO:19	SLPQNILPL
SEQ ID NO:20	TQTPVVVPPF
SEQ ID NO:21	LQPEIMGVPKVKETMVPK
SEQ ID NO:22	HKEMPFPKYPVEPFTESQ
SEQ ID NO:23	SLTLTDVEKLHLPLPLVQ
SEQ ID NO:24	SWMHQPP
SEQ ID NO:25	QPLPPTVMFP
SEQ ID NO:26	PQSVLS

SEQ ID NO:27	LSQPKVLPVPQKAVPQRDMPIQ
SEQ ID NO:28	AFLLYQE
SEQ ID NO:29	RGPFPILV
SEQ ID NO:30	ATFNRYQDDHGEEILKSL
SEQ ID NO:31	VESYVPLFP
SEQ ID NO:32	FLLYQEPVLGPVR
SEQ ID NO:33	LNF
SEQ ID NO:34	MHQPPQPLPPTVMFP

We claim:

1. A method for modulating the oxidative stress level in a cell, the method comprising contacting the cell with an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof, under conditions effective to change the level of an oxidizing species in the cell compared to the same conditions when the oxidative stress regulator is not present.

2. The method of claim 1 wherein the cell is present in a cell culture, a tissue, an organ, or an organism.

3. The method of claim 1 wherein the cell is a mammalian cell.

4. The method of claim 3 wherein the cell is a human cell.

5. The method of claim 1 wherein the oxidative stress regulator is a constituent peptide of colostrinin.

6. The method of claim 5 wherein the oxidative stress regulator is selected from the group of MQPPPLP (SEQ ID NO:1), LQTPQPLLQVMMEPQGD (SEQ ID NO:2), DQPPDVEKPDLQPFQVQS (SEQ ID NO:3), LFFFLPVVNVLP (SEQ ID NO:4), DLEMPVLPVEPFPFV (SEQ ID NO:5), MPQNFYKLPQM (SEQ ID NO:6), VLEMKFPPPPQETVT (SEQ ID NO:7), LKPFPKLKVEVFPFP (SEQ ID NO:8), VVMEV (SEQ ID NO:9), SEQP (SEQ ID NO:10), DKE (SEQ ID NO:11), FPPPK (SEQ ID NO:12), DSQPPV (SEQ ID NO:13), DPPPPQS (SEQ ID NO:14), SEEMP (SEQ ID NO:15), KYKLQPE (SEQ ID NO:16), VLPPNVG (SEQ ID NO:17), VYPFTGPIPN (SEQ ID NO:18), SLPQNILPL (SEQ ID NO:19), TQTPVVVPPF (SEQ ID NO:20), LQPEIMGVPKVKETMVPK (SEQ ID NO:21),

HKEMPFPKYPVEPFTESQ (SEQ ID NO:22), SLTLTDVEKLHLPLPLVQ (SEQ ID NO:23), SWMHQPP (SEQ ID NO:24), QPLPPTVMFP (SEQ ID NO:25), PQSVLS (SEQ ID NO:26), LSQPKVLPVPQKAVPQRDMPIQ (SEQ ID NO:27), AFLLYQE (SEQ ID NO:28), RGPFPILV (SEQ ID NO:29), ATFNRYQDDHGEEILKSL (SEQ ID NO:30), VESYVPLFP (SEQ ID NO:31), FLLYQEPVLGPVR (SEQ ID NO:32), LNF (SEQ ID NO:33), and MHQPPQPLPPTVMFP (SEQ ID NO:34), and combinations thereof.

7. The method of claim 6 wherein the oxidative stress regulator is selected from the group of MQPPPLP (SEQ ID NO:1), LQTPQPLLQVMMEPQGD (SEQ ID NO:2), DQPPDVEKPDLQPFQVQS (SEQ ID NO:3), LFFFLPVVNVLP (SEQ ID NO:4), DLEMPVLPVEPFPFV (SEQ ID NO:5), MPQNFYKLPQM (SEQ ID NO:6), VLEMKFPPPPQETVT (SEQ ID NO:7), LKPFPKLKVEVFPFP (SEQ ID NO:8), and combinations thereof.

8. A method for modulating the oxidative stress level in a cell, the method comprising contacting the cell with an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof, under conditions effective to prevent an increase in the level of an oxidizing species in the cell compared to the same conditions when the oxidative stress regulator is not present.

9. A method for modulating the oxidative stress level in a patient, the method comprising administering to the patient an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof, under conditions effective to change the level of an oxidizing species in the patient compared to the same conditions when the oxidative stress regulator is not present.

10. The method of claim 9 wherein the oxidative stress regulator is a constituent peptide of colostrinin.

11. The method of claim 10 wherein the oxidative stress regulator is selected from the group of MQPPPLP (SEQ ID NO:1), LQTPQPLLQVMMEPQGD (SEQ ID NO:2), DQPPDVEKPDLQPFQVQS (SEQ ID NO:3), LFFFLPVVNVLP (SEQ ID NO:4), DLEMPVLPVEPFPFV (SEQ ID NO:5), MPQNFYKLPQM (SEQ ID NO:6), VLEMKFPPPPQETVT (SEQ ID NO:7), LKPFPKLKVEVFPFP (SEQ ID NO:8), VVMEV (SEQ ID NO:9), SEQP (SEQ ID NO:10), DKE (SEQ ID NO:11), FPPPK (SEQ ID NO:12), DSQPPV (SEQ ID NO:13), DPPPPQS (SEQ ID NO:14), SEEMP (SEQ ID NO:15), KYKLQPE (SEQ ID NO:16), VLPPNVG (SEQ ID NO:17), VYPFTGPIPN (SEQ ID NO:18), SLPQNILPL (SEQ ID NO:19), TQTPVVVPPF (SEQ ID NO:20), LQPEIMGVPKVKETMVPK (SEQ ID NO:21), HKEMPFPKYPVEPFTESQ (SEQ ID NO:22), SLTLTDVEKLHLPLPLVQ (SEQ ID NO:23), SWMHQPP (SEQ ID NO:24), QPLPPTVMFP (SEQ ID NO:25), PQSVLS (SEQ ID NO:26), LSQPKVLPVPQKAVPQRDMPIQ (SEQ ID NO:27), AFLLYQE (SEQ ID NO:28), RGPFPILV (SEQ ID NO:29), ATFNRYQDDHGEEILKSL (SEQ ID NO:30), VESYVPLFP (SEQ ID NO:31), FLLYQEPVLGPVR (SEQ ID NO:32), LNF (SEQ ID NO:33), and MHQPPQPLPPTVMFP (SEQ ID NO:34), and combinations thereof.

12. The method of claim 11 wherein the oxidative stress regulator is selected from the group of MQPPPLP (SEQ ID NO:1), LQTPQPLLQVMMEPQGD (SEQ ID NO:2), DQPPDVEKPDLQPFQVQS (SEQ ID NO:3), LFFFLPVVNVLP (SEQ ID NO:4), DLEMPVLPVEPFPFV (SEQ ID NO:5), MPQNFYKLPQM

(SEQ ID NO:6), VLEMKFPPPPQETVT (SEQ ID NO:7), LKPFPKLKVEVFPFP (SEQ ID NO:8), and combinations thereof.

13. The method of claim 9 wherein the oxidative stress regulator is administered as part of a dietary supplement.

14. The method of claim 9 wherein the oxidative stress regulator is administered as part of a topical formulation.

15. The method of claim 9 wherein the patient is an animal.

16. The method of claim 15 wherein the patient is a human.

17. A method for modulating the oxidative stress level in a patient, the method comprising administering to the patient an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof, under conditions effective to prevent an increase in the level of an oxidizing species in the patient compared to the same conditions when the oxidative stress regulator is not present.

18. A method of treating oxidative damage to the skin of a patient, the method comprising applying to skin a topical formulation comprising an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof, under conditions effective to decrease or prevent an increase in the level of damage to a biomolecule of the patient selected from the group of a DNA, a protein, a lipid, or combinations thereof, compared to the same conditions when the oxidative stress regulator is not present.

19. The method of claim 18 wherein the oxidative stress regulator is a constituent peptide of colostrinin.

20. The method of claim 19 wherein the oxidative stress regulator is selected from the group of MQPPPLP (SEQ ID NO:1), LQTPQPLLQVMMEPQGD (SEQ ID NO:2), DQPPDVEKPDLQPFQVQS (SEQ ID NO:3), LFFFLPVVNVLP (SEQ ID NO:4), DLEMPVLPVEPFPFV (SEQ ID NO:5), MPQNFYKLPQM (SEQ ID NO:6), VLEMKFPPPPQETVT (SEQ ID NO:7), LKPFPKLKVEVFPFP (SEQ ID NO:8), VVMEV (SEQ ID NO:9), SEQP (SEQ ID NO:10), DKE (SEQ ID NO:11), FPPPK (SEQ ID NO:12), DSQPPV (SEQ ID NO:13), DPPPPQS (SEQ ID NO:14), SEEMP (SEQ ID NO:15), KYKLQPE (SEQ ID NO:16), VLPPNVG (SEQ ID NO:17), VYPFTGPIPN (SEQ ID NO:18), SLPQNILPL (SEQ ID NO:19), TQTPVVVPPF (SEQ ID NO:20), LQPEIMGVPKVKETMVPK (SEQ ID NO:21), HKEMPFPKYPVEPFTESQ (SEQ ID NO:22), SLTLTDVEKLHLPLPLVQ (SEQ ID NO:23), SWMHQPP (SEQ ID NO:24), QPLPPTVMFP (SEQ ID NO:25), PQSVLS (SEQ ID NO:26), LSQPKVLPVPQKAVPQRDMPIQ (SEQ ID NO:27), AFLLYQE (SEQ ID NO:28), RGPFPILV (SEQ ID NO:29), ATFNRYQDDHGEEILKSL (SEQ ID NO:30), VESYVPLFP (SEQ ID NO:31), FLLYQEPVLGPVR (SEQ ID NO:32), LNF (SEQ ID NO:33), and MHQPPQPLPPTVMFP (SEQ ID NO:34), and combinations thereof.

21. The method of claim 20 wherein the oxidative stress regulator is selected from the group of MQPPPLP (SEQ ID NO:1), LQTPQPLLQVMMEPQGD (SEQ ID NO:2), DQPPDVEKPDLQPFQVQS (SEQ ID NO:3), LFFFLPVVNVLP (SEQ ID NO:4), DLEMPVLPVEPFPFV (SEQ ID NO:5), MPQNFYKLPQM (SEQ ID NO:6), VLEMKFPPPPQETVT (SEQ ID NO:7), LKPFPKLKVEVFPFP (SEQ ID NO:8), and combinations thereof.

22. The method of claim 18 wherein the patient is a human.

23. A method of modulating the oxidative stress level of the skin of a patient, the method comprising applying to skin a topical formulation comprising an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof, under conditions effective to change the level of damage to a biomolecule of the patient selected from the group of a DNA, a protein, a lipid, or combinations thereof, compared to the same conditions when the oxidative stress regulator is not present.

24. A cosmetic formulation comprising an oxidative stress regulator selected from the group of colostrinin, a constituent peptide thereof, an active analog thereof, and combinations thereof.

25. The method of claim 24 wherein the oxidative stress regulator is a constituent peptide of colostrinin.

26. The method of claim 25 wherein the oxidative stress regulator is selected from the group of MQPPPLP (SEQ ID NO:1), LQTPQPLLQVMMEPQGD (SEQ ID NO:2), DQPPDVEKPDLQPFQVQS (SEQ ID NO:3), LFFFLPVVNVLP (SEQ ID NO:4), DLEMPVLPVEPFPFV (SEQ ID NO:5), MPQNFYKLPQM (SEQ ID NO:6), VLEMKFPPPPQETVT (SEQ ID NO:7), LKPFPKLKVEVFPFP (SEQ ID NO:8), VVMEV (SEQ ID NO:9), SEQP (SEQ ID NO:10), DKE (SEQ ID NO:11), FPPPK (SEQ ID NO:12), DSQPPV (SEQ ID NO:13), DPPPPQS (SEQ ID NO:14), SEEMP (SEQ ID NO:15), KYKLQPE (SEQ ID NO:16), VLPPNVG (SEQ ID NO:17), VYPFTGPIPN (SEQ ID NO:18), SLPQNILPL (SEQ ID NO:19), TQTPVVVPPF (SEQ ID NO:20), LQPEIMGVPKVKETMVPK (SEQ ID NO:21), HKEMPFPKYPVEPFTESQ (SEQ ID NO:22), SLTLTDVEKLHLPLPLVQ (SEQ ID NO:23), SWMHQPP (SEQ ID

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27. The method of claim 26 wherein the oxidative stress regulator is selected from the group of MQPPPLP (SEQ ID NO:1), LQTPQPLLQVMMEPQGD (SEQ ID NO:2), DQPPDVEKPDLQPFQVQS (SEQ ID NO:3), LFFFLPVVNVLP (SEQ ID NO:4), DLEMPVLPVEPFPFV (SEQ ID NO:5), MPQNFYKLPQM (SEQ ID NO:6), VLEMKFPPPPQETVT (SEQ ID NO:7), LKPFPKLKVEVFPFP (SEQ ID NO:8), and combinations thereof.

FIGURE 1. Fundamentals of ROS Determination

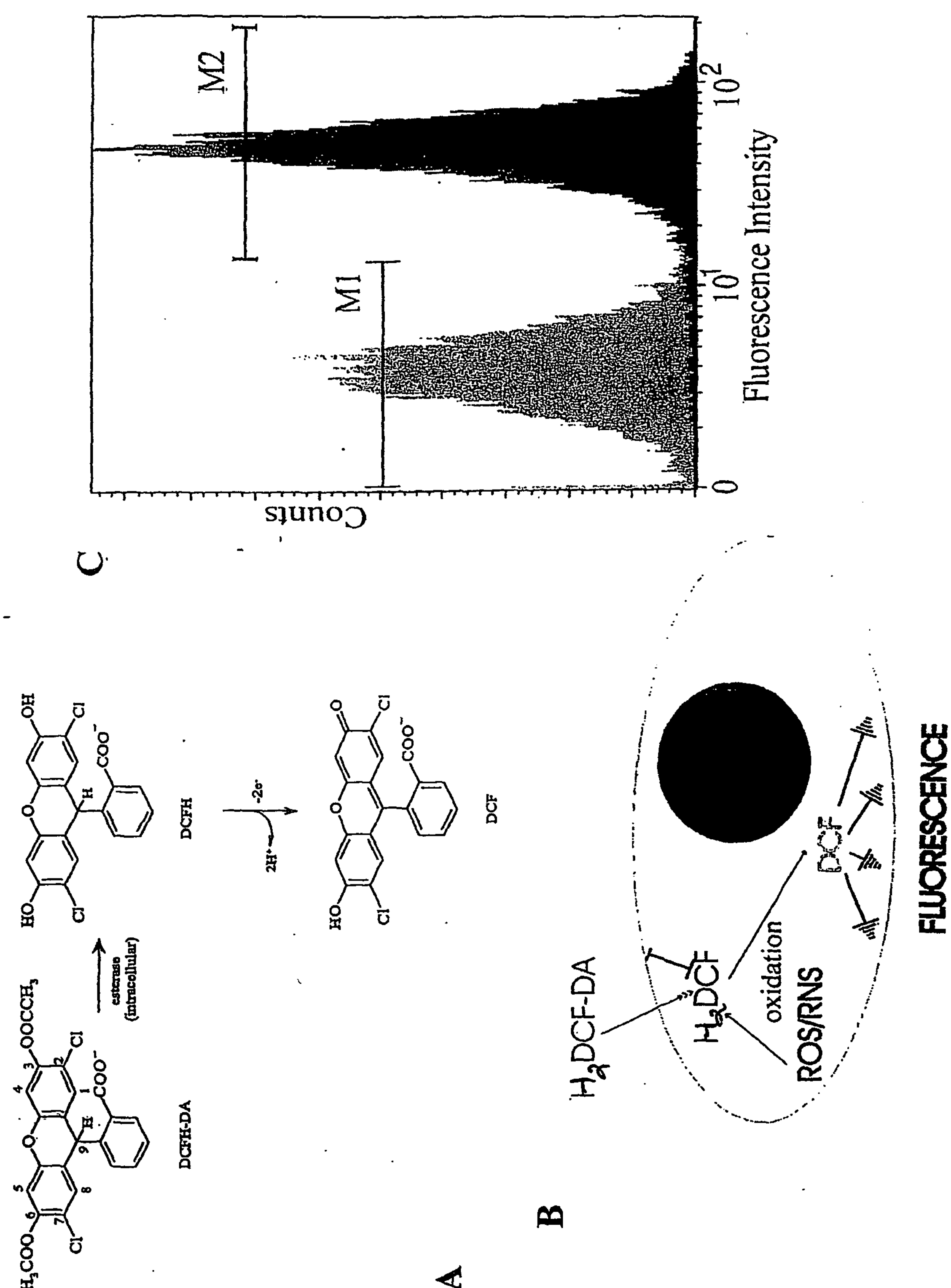
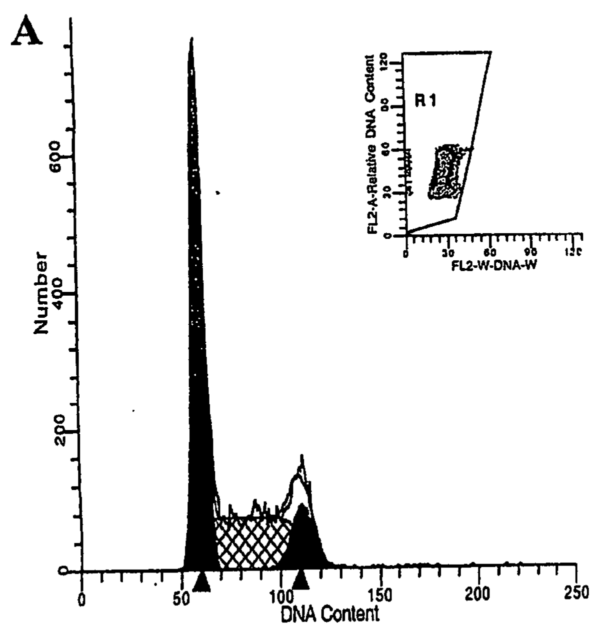


FIGURE 2

Cell Cycle Stage Distribution of Actively Replicating PC12 (A) and ECV304 (B) Cells

A



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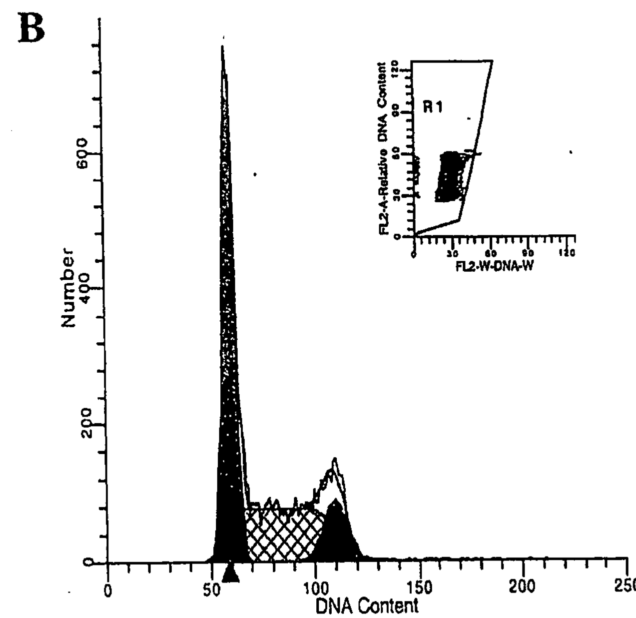


FIGURE 3

Change in ROS Levels in PC12 Cells After Addition of H_2O_2 or TPA Determined by Flow Cytometry

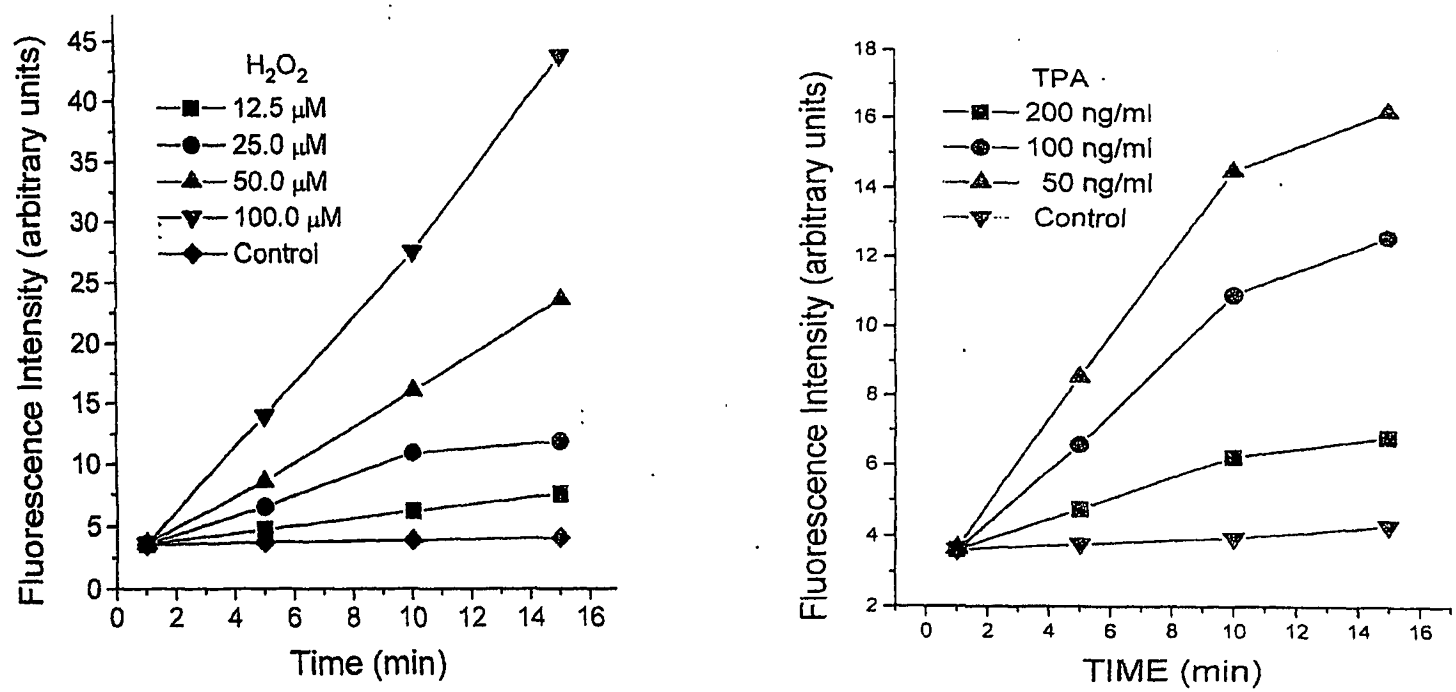


FIGURE 4

Anti-oxidant Effect of NAC, BHA and Catalase in PC12 Cells

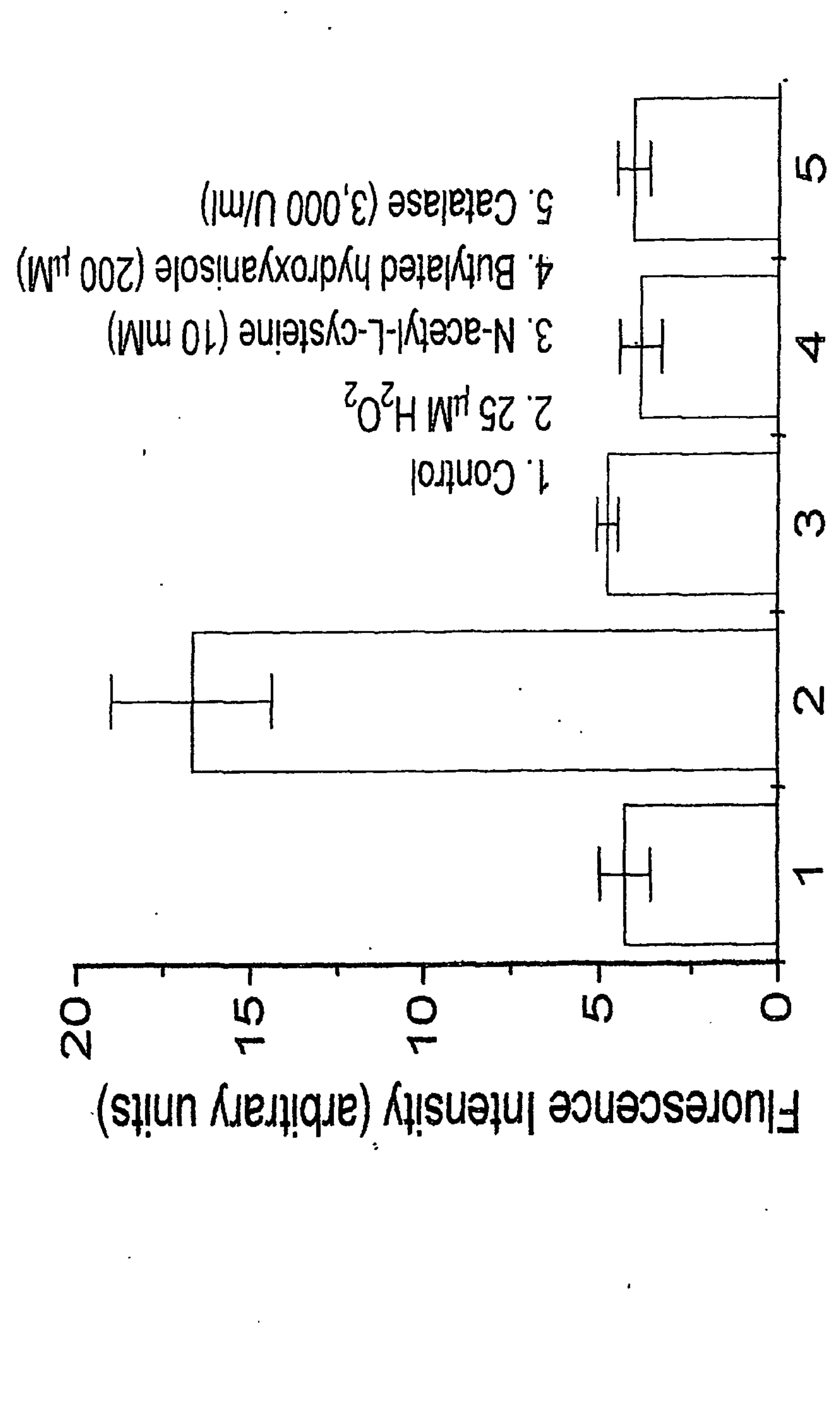


FIGURE 5

Colostrum, Colostrinin and its Constituent Peptides Inhibit Oxidation of H2DCF

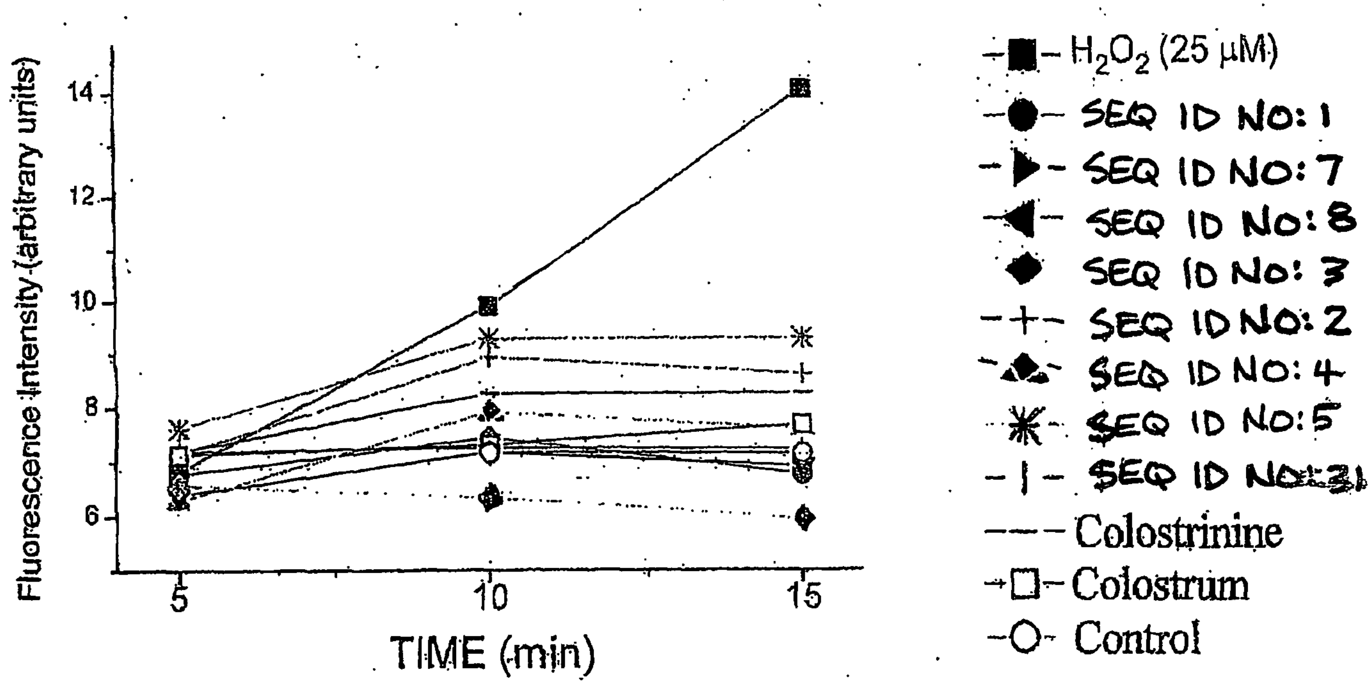


FIGURE 6

Colostrum, Colostrinin and Constituent Peptides TPA-Mediated ROS Production

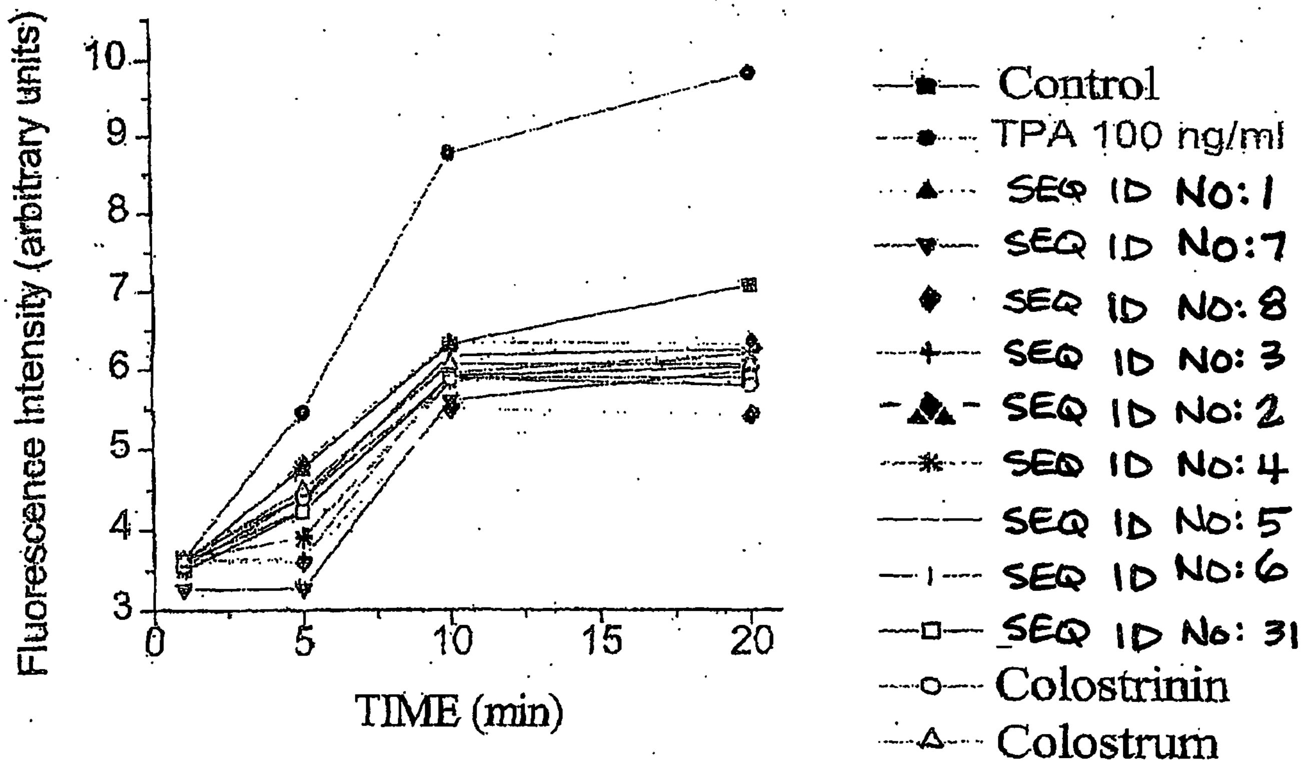
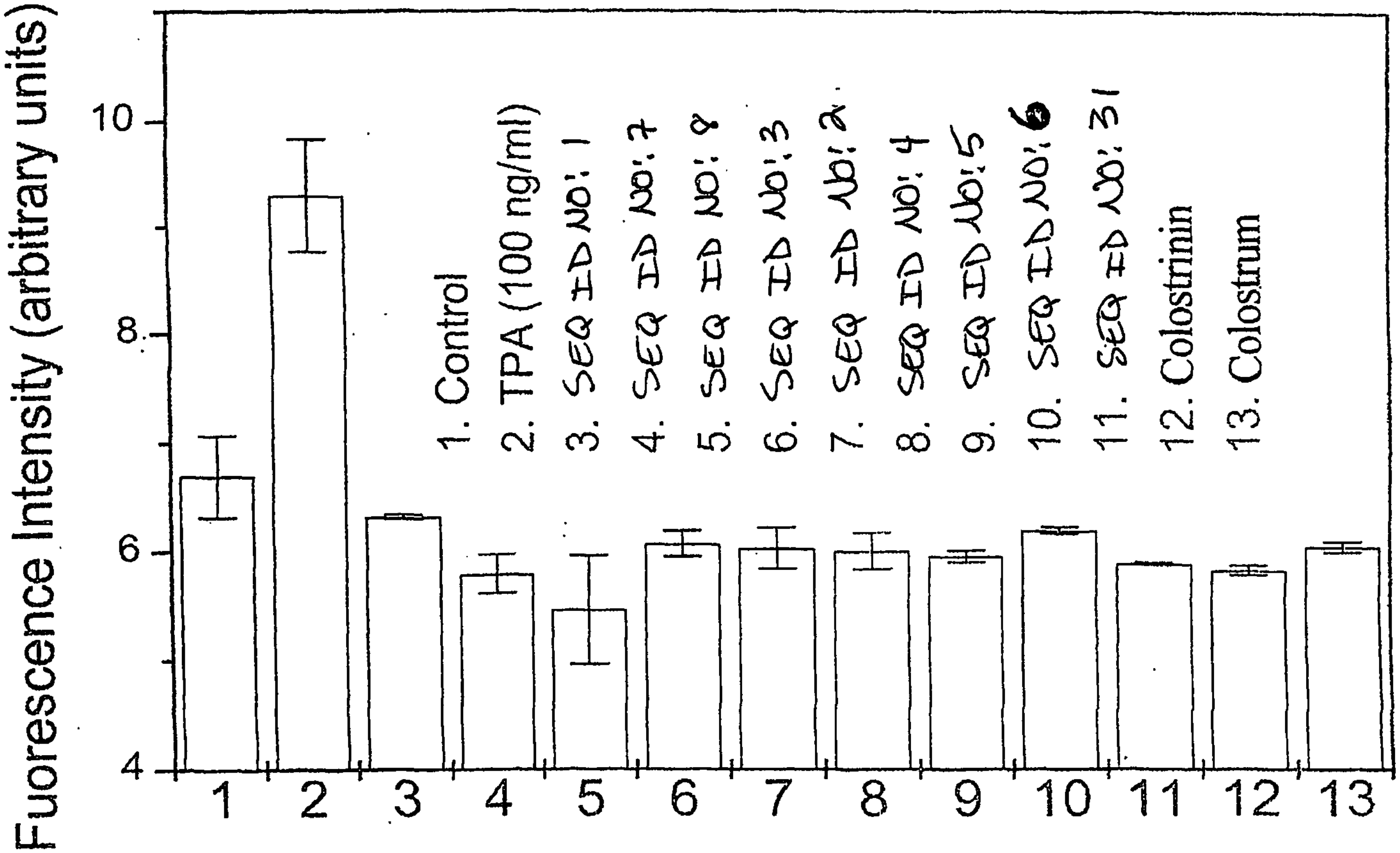


FIGURE 7

Reduction in TPA-induced ROS Levels in the Presence of Amino Acid Motifs, Colostrinin and Colostrum



SEQUENCE LISTING

<110> THE UNIVERSITY OF TEXAS SYSTEM
STANTON, G. John
HUGHES, Thomas K.
BOLDOGH, Istvan

<120> USE OF COLOSTRININ, CONSTITUENT PEPTIDES THEREOF, AND ANALOGS THEREOF AS OXIDATIVE STRESS REGULATORS

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<140> Unassigned
<141> 2000-08-17

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/22776

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61K38/17 A61K7/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

MEDLINE, PAJ, WPI Data, BIOSIS, CHEM ABS Data, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Section Ch, Week 199411 Derwent Publications Ltd., London, GB; Class B04, AN 1994-089332 XP002155477 -& JP 06 041191 A (CALPIS SHOKUHIN KOGYO KK), 15 February 1994 (1994-02-15) See abstract and seq. 1-23	1-6, 8-11, 13-20, 22-26
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X	WO 98 14473 A (JANUSZ MARIN ;LISOWSKI JOZEF (PL); DUBOWSKA INGLOT ANNA (PL); HIRS) 9 April 1998 (1998-04-09) the whole document	24,25

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

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Date of the actual completion of the international search	Date of mailing of the international search report
12 June 2001	22/06/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Groenendijk, M

INTERNATIONAL SEARCH REPORT

ational Application No
PCT/US 00/22776

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
E	WO 00 75173 A (REGEN THERAPEUTICS PLC ;GEORGIADES JERZY A (US)) 14 December 2000 (2000-12-14) the whole document	24-27

INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/US 00/22776

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
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WO 0112650	A	22-02-2001	NONE			
WO 9814473	A	09-04-1998	PL	316416	A	14-04-1998
			AU	4565197	A	24-04-1998
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